



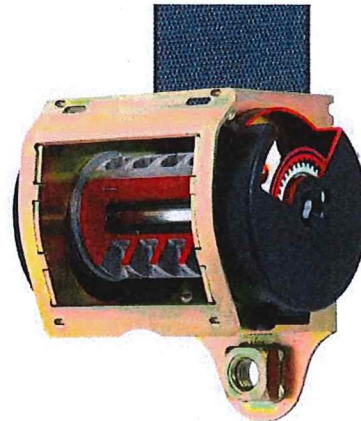
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Seatbelt Retractors

Seatbelt retractors store unused webbing and lock the webbing in a crash. Modern retractors have two independent sensors (i.e. webbing sensors and vehicle sensors) to provide high reliability.

A seatbelt retractor uses a spool as its central element. The spool (or spindle) is attached to one end of the webbing. Inside the retractor, a spring applies a rotation force. This works to rotate the spool so it winds up any loose webbing. When you pull the webbing out, the spool rotates counter-clockwise, which turns the attached spring in the same direction. Effectively, the rotating spool works to untwist the spring. The spring wants to return to its original shape, so it resists this twisting motion. If you release the webbing, the spring will tighten up, rotating the spool clockwise until there is no more slack in the belt.



All Autoliv retractors have two sensors that work independently on the locking mechanism. The vehicle sensor detects sudden deceleration of the vehicle, while the webbing sensor detects violent pull-outs of webbing from the retractor. The world's first seatbelt retractor (the "Essem Retractor") was invented by Autoliv in 1968.

Load limiter

Autoliv's load limiters minimize the risk for rib fracture from the seatbelt in very violent crashes. This is especially important for elderly, since studies have shown that a 60 year old person can only take half as much load on his rib cage as a twenty year old person.

Load limiters keep the belt force at a controlled and pre-defined level. This is accomplished by a mechanism in the retractor that allows webbing to be pulled out slightly - and in a controlled way - if the load on an occupant's body becomes too high in a violent crash. The system is typically used in combination with an airbag which then absorbs the excessive energy.

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The load limiter is typically integrated with the retractor, where a specially designed bar holds the spindle with the webbing. When the force from the webbing reaches a pre-set level, the bar will twist, allowing the spindle to turn and thereby limiting the load on the occupant's chest.

Seatbelt systems with load limiters typically also have pretensioners that reduce the forward motion of the occupant by tightening the belt at the onset of a crash.

The first load limiter on the world market was introduced in 1995 by Autoliv in cooperation with Renault.

Degressive load limiter

To further optimize the consistent restraining load from seatbelts and airbags, Autoliv has introduced load limiters that provide a digressive load characteristic. In the initial onset of the crash, when the occupant is only restrained by the belt, the restraining force of the seatbelt is held at a relatively high, constant level. As the occupant moves forward and into the airbag, the belt's load limiter moves down to a lower restraining force, "a lower gear", to prevent the risk of peak loads that could occur if the restraining forces of the two safety systems were added to each other. The digressive system therefore gives a high and relatively even load on the occupant's chest during the whole crash. The introduction of the digressive load limiter systems began in 2000, starting with some BMW and Volvo models.

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